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AUTHOR Setzler, Hubert H., Jr.; Clark, Richard E.
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ABSTRACT

Four presentations in two recall conditions (immediate and one-week delay) were used to investigate the combined effects of imagery and semantic organizational strategies on the free recall of 80 college undergraduates. Both imaginal and semantic organization were comparably manipulated presenting each response noun simultaneously with an imagery pegword and a semantic category label. The to-be-remembered (TBR) nouns were given either in a consecutive, uninterrupted (massed) order or an interspaced (distributed) order with both cue-terms (imaginal pegword and semantic category label). The massed ordering was significant for semantics, but not for imagery. Interaction effects were tentatively concluded to be the result of differences in the organizational properties of short-term and long-term memory. Imagery was found to be a little-used organizational strategy by the students. Semantic categories, however, were shown to be a powerful strategy for the organization and retrieval of the TBR nouns in both short-term and long-term memory. (Author)

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Imaginal and Semantic Strategies: Differential Effects on Free Recall

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HUBERT H. SETZLER, JR.

Development & Evaluation Associates, Inc.

and

RICHARD E. CLARK

University of Southern California

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Address correspondence to: Hubert H. Setzler, Jr., 700 East Water Street, Midtown Plaza, Development & Evaluation Associates, Inc., Syracuse, N.Y. 13210

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Abstract

Four presentations in two recall conditions (immediate and one-week delay) were used to investigate the combined effects of imagery and semantic organizational strategies on free recall. Both imaginal and semantic organization were comparably manipulated presenting each response noun simultaneously with an imagery pegword and a semantic category label. The to-be-remembered (TBR) nouns were given either in a consecutive, uninterrupted (massed) order or an interspaced (distributed) order with both cue-terms (imaginal pegword and semantic category label). The massed ordering was significant for semantics, but not for imagery. Interaction effects were tentatively concluded to be the result of differences in the organizational properties of short-term (STM) and long-term memory (LTM). Imagery was found to be a little used organizational strategy by university students. Semantic categories, however, were shown to be a powerful strategy for the organization and retrieval of the TBR nouns in both STM and LTM.

Imaginal and Semantic Organizational Strategies: Differential Effects on Free Recall

This study investigated the differential effects of imaginal and semantic organization on free recall in both immediate and delayed conditions. Research on imagery mnemonics has shown interactive images to be an important factor in paired-associate tasks (Bugelsiki, 1968; Paivio, 1971; Bower, 1972). Investigations of semantic organization suggest that memory is hierarchically organized (Mandler, 1968; Bower, Clark, Lesgold, & Winznenz, 1969; Wortman, 1975).

Contemporary research on the organizational processes of memory generally stress verbal rather than visual structuring. Wickens (1972) demonstrated a strong perference for semantic encoding over that of imagery encoding. Indeed, the study implied that imagery itself was an insignificant and unimportant factor in organization. In apparent contrast with Wickens are the experiments employing imagery instructions designed to promote the clustering of items through interactive-images. These interactive-image organizational strategies, usually called imagery mnemonics, have been shown to have powerful effects on recall (Bower, 1970, 1972; Paivio, 1971).

Two concerns directed the focus of this research. The first was the intent to examine imagery as an organizational variable in free-recall strategies. That is, the concept of "picturability" was not under investigation. The findings of those studies that have manipulated such factors as imagery valve, concreteness, and vividness (Tulving, McNulty, & Ozier, 1965; Paivio, Yuille, & Rogers, 1969) represented variables to be controlled, rather than manipulated.

The second concern was to find a way to compare imagery with semantics as organizational strategies in free recall. Imagery, as a variable, is traditionally an area of investigation separate from semantics. To establish a basis of comparability between the two variables, a hierarchical model of memory (Mandler, 1968) was used to guide the research. This model can adequately describe and account for both semantic and imaginal phenomena with respect to organizational characteristics. Although his examples are semantic ones, Mandler was careful to point out that units in one organizational hierarchy could participate in other organizational hierarchies. Membership in one hierarchy does not preclude membership in any number of others. This means that subjects, when learning words for later recall, could develop different kinds of hierarchies. In the present experiment both semantic and imaginal organizational strategies for constructing such hierarchies were made readily available to the learners. They could cluster the semantic features (the meanings) of the words into hierarchies of those features. These same words could also be structured into "chains" of interactive images--hierarchies based on patterns or arrangements of the images evoked by the words.

With respect to semantics, the Mandler model posits the concept of chunking or unitization of items in memory. Recoding takes place when any group of items is given a unitizing label, i.e., carrots, celery, and spinach can be recoded as vegatables. Items are retrieved on the basis of this hierarchically categorized structure. Verbal learning and memory account for the restructuring of units already organized in a permanent storage system.

In essence, Mandler's view is that items are retrieved as interdependent units. Recall of one item effects the recall of another. Immediate memory

span sets a limit on what can be stored and retrieved. Since recall can exceed the limits imposed by immedate memory span, the items must be unitized into some higher-order category. The formation these units is related to factors of direct and indirect association, language habits, conceptual similarity, etc. The degree of retrieval depends on the degree of organization that is possible.

In this experiment, the to-be-remembered nouns are presented in treatments constructed so that subjects could take advantage of the semantic features, the interactive-image associations, or both. The treatment design was based on Bower's (1972) conclusion that when items are associated with a particular cue-term (the stimulus), the recall probabilities are high, if the to-be-remembered items are given simultaneously or in consecutive serial order, so that subjects can integrate the items with the cue-term. If the to-be-remembered items involving the same cue-term are presented singly, separated in time by intervening pairs involving other cue-terms, the recall probabilities are lowered.

This study used semantic category labels as the cue-terms that facilitated the integration of the semantic features around a particular subordinate category. For example, the semantic category label, occupation, served as the cue-term for such to-be-remembered nouns as doorman, butcher, and blacksmith. According to Bower (1972), recall should be higher, if the pairs occupation-doorman, occupation-butcher, occupation-blacksmith are presented in an uninterrupted sequence. If different cue-term and associated-noun pairs are inserted into the presentation to interrupt the consecutive order of the occupation-associated-noun pairs, recall should diminish.

In an attempt to take advantage of the organizational potential of imagery, our study employed a mnemonic device requiring the use of interactive images. This device provided a list of pegwords that rhyme with the numerals 1 through 10 (1-BUN, 2-SHOE, 3-TREE, etc.). Rhyming, itself, is considered unimportant, but is used to facilitate the initial learning of the pegwords and to impose a serial order for encoding and subsequent retrieval. Any word can then be stored in memory by forming an interactive image between the word to be remembered and the pegword. The serial order the pegwords provides the learner with a systematic retrieval strategy, a "cognitive mapping" of the location of the stored units.

The present study sought a method of touching both imagery and verbal phenomena as organizational processes. How do these two factors compete with or complement each other? Will learners incorporate both organizational strategy or will they supress one in favor of the other? Since Wickens (1972) concluded that semantic taxonomic categories are a much more popular learning strategy for college students than imagery, an attempt was made to require that subjects initially learn the response words via an imagery-based pegword mnemonic.

Method

Subjects

80 Syracuse University undergraduate students were paid volunteers.

Materials

For this experiment, 49 nouns with Imagery, Concreteness, and Meaningfulness ratings greater than 5.00 were selected from the norms established by Paivio, Yuille, and Madigan (1968). These nouns were equally divided

into 7 sets. Each of the 7 sets could be considered to belong to one of 7 semantic categories: OCCUPATIONS, ANIMALS, PARTS OF THE BODY, FOODS, MILITARY, BUILDINGS, AND WATER.

An abbreviated pegword mnemonic of the type employed by Bugelski, Kidd, and Segman (1968) was also used for organizing the 49 TBR (to-be-remembered) nouns. This mnemonic was a 7-member, number rhyming-pegword: 1-BUN, 2-SHOE, 3-TREE, 4-DOOR, 5-HIVE, 6-Stick, 7-HEAVWN.

Forty-nine Kodalith slides were constructed with three types of information on each slide: (a) a number pegword; (b) a TBR noun; and (c) the semantic category to which the TBR noun belonged (Gifure 2). All letters were capitalized and measured 1 cm in height when projected on the screen. The slides, the medium of presentation, were sequentially ordered according to the demands of the treatments.

Insert Figure 1 about here

Procedures

Subjects participated in the experiment individually and were randomly assigned to treatments. Each subject memorized the rhyming pegword menmonic to 5 perfect replications. Subjects were then given instructions on forming interactive images with the pegwords and the TBR nouns.

Each subject was given standard instructions on the tasks to be performed. During the presentation, the subject sat 1½ m from the screen. Six warm-up slides prepared the subject for the particular assigned presentation. The 49 treatment slides followed. Subjects attempted to form an interactive

image with the number-pegword and the TBR noun on each slide to facilitate later recall of the TBR nouns. No instructions were given concerning the semantic category labels in parenthesis. In accordance with Bugelski (1968) and Keppel and Zavortink (1969), subjects viewed each slide for 8 seconds. Presentation rate was controlled by an 8-second synchronizer on a Kodak Ektagraphic slide projector.

Following the presentation of the slides, immediate-recall subjects were instructed to write down as many of the nouns as they could. The delayed-recall subjects were instructed to return in one week. After a 7-minute period for recalling items, each subject was interviewed in an effort to gain his personal account of the organizing strategies used and their relative and potential effectiveness.

Scoring (the number of correct items recalled) was conducted according to the following criteria: (a) words not among the TBR list were ignored; (b) no penalty was incurred for misspellings; and (c) the recall order of the TBR nouns was not considered in the scoring.

Design

The basic design consisted of a 2x2x2 completely randomized factorial with 10 subjects in each cell. The 3 independent variables were: pegword mnemonic (massed vs distributed), semantic organization (massed vs distributed), and recall condition (immediate recall or a one-week delay).

The 8 treatments consisted of 4 slide presentations and 2 recall conditions. The 4 slide sequencings allowed for all possible combinations of massing and/or distributing under pegwords and semantic categories. Each subject

was randomly assigned to 2 of the 4 slide presentations in either the immediate or delayed recall condition.

Massing. For this experiment massing was the process of associating words with a single semantic label or pegword in an uninterrupted series. For the pegword mnemonic, the nouns doorman, butcher, priest, etc., were associated with the pegword 1-BUN, before the nouns hound, alligator, beaver, etc., were associated with the pegword 2-SHOE. For semantic organization, the nouns doorman, butcher, priest, etc., were learned under the category label OCCUPATION, before hound, alligator, beaver, etc., were presented with the semantic category label ANIMAL.

Distributed. The distributed condition required that subjects associate a single noun with a single pegword or semantic category label and then associate a new noun with a new pegword or semantic category label until all the pegwords or semantic category labels were used once. The process was then repeated until all of the TBR nouns had been presented. For the pegword mnemonic the distributed associative process was 1-BUN and a TBR noun, 2-SHOE and a TBR noun, 3-TREE and a TBR noun, etc. For semantic organization the distributed process was OCCUPATION plus a TBR noun naming an occupation, then ANIMAL plus a TBR noun naming an animal, then PARTS OF THE BODY plus a TBR noun naming a part of the body. This process was repeated until all 49 TBR nouns had been presented to the subject (Figure 1).

Results

Table 1 presents the mean recall scores as a function of the principle conditions of the experiment. The analysis of variance (MS_e=67.242) indicated

that main effects of semantic organization, $F(2,72)=5.46, p > .05$, and response condition, $F(1,72)=43.37$, $p > .001$, were statistically significant, but that the pegword mnemonic was not, $F(1,72)=1.82$. More TBR nouns were recalled when massed under the semantic category labels than when distributed. Immediate recall was superior to delayed. The only other significant source in the analysis was the two-way interaction between the pegword mnemonic and semantic organization, $F(1,72)=4.13$, $p < .05$.

Insert Figure 2 about here

Figure 2 shows this interaction to be an ordinal one. Tests for simple main effects on this interaction revealed statistical significance for the pegword mnemonic at the semantic organization massed level, $F(1,72)=5.77$, $p < .025$, and for semantic organization at the pegword mnemonic massed level, $F(1,72)=9.52$, $p < .01$.

Insert Figure 3 about here

A further analysis of the interaction effect investigated the differences between the immediate and delayed recall conditions. Figure 3 reveals a disordinal interaction in the delayed recall condition, $F(1,26)=6.47$, $p < .015$, while in the immediate recall condition no interaction is present.

Sunnet's test was used for comparing the other group means the mean of the PMSM (pegword mnemonic massed and semantic organization massed) in both the immediate and delayed recall conditions. The two-tailed value from Dunnet's table was 2.47 ($a=.05$, $k=4$, $df=36$). The critical difference for

the immediate recall groups was d'=8.55. One comparison, PMSM and PDSD (pegword mnemonic distributed and semantic organization distributed) was statistically significant (d'=10.4). This supports Bower's (1972) prediction that blocking or serially consecutive presentations of response items with cue-terms will result in higher recall probalities.

In the delayed recall condition, where the critical difference was d'=9.53, only the comparision between PMSM and PMSD (pegword mnemonic massed and semantic organization distributed was significant (d'=9.7). Contrary to the finding in the immediate recall condition, there was no significant difference between the PMSM and PDSD (d'=3.1). This is apparently counter to Bower's prediction.

Discussion

Semantic Organization

The significant main effect for semantic organization supports the work of Bower (1970), Bower, Clark, Lesgold, and Winzenz (1969), and Wickens (1972). Bower et al. (1969) presented subjects with semantically organized material. Those who received the material in blocked hierarchies recall much more than those who received scrambled hierarchies. In the present study massing under semantic category labels was predicted to function somewhat like the blocked hierarchies. Massing apparently allowed subjects to employ a strategy for encoding and subsequent recall that is predictable by an organizational hypothesis. These predictions held up in both the immediate and delayed recall conditions as well as across the two levels of the imagery strategy.

Pegword Mnemonic

The pegword mnemonic variable accounted for less than one percent of the

total variance. The implication here is that an imagery mnemonic strategy for organizing items in memory is not a popular one for university students. At least, when given only 8 seconds to form coded images for later recall, subjects tended to rely on the semantic features of the nouns. Post treatment interviews of subjects believed learning and recall strategies support this view. Thus the massing of nouns on pegwords apparently had little effect on recall when semantic cues are available.

This finding appears to be inconsistent with Paivio's (1971) discussions of the organizational possibliities of imagery mnemonic systems and Bower's (1972) study of massed and separate imagery instructions. However, this study differed from Bower's study in two distinct ways: (a) instructions for linking images together to form chains were omitted and (b) an alternative semantic strategy for encoding the nouns was included.

However, analysis of the simple main effects of the first-order interaction (pegword mnemonic and semantic organization) did reveal that pegword mnemonic was a small, but statistically significant factor in recall when semantic organization was held at the massed level. The superior massing of images on the pegword (Bowers, 1972) was, in general, employed by subjects as an adjunctive strategy supplementing the preferred semantic one. Evidently, as Wickens (1972) pointed out, "the human adult has the potential for using, and perhaps uses, a multiple information processing system in the brief duration that the symbolic data are made available to him" (page 200).

Recall Condition

In the immediate recall condition, the results are fairly straight forward, i.e., massing on semantic or pegword cue-terms produced higher recall scores.

The situation in the delayed condition is, however, quite complicated. The resulting disordinal interaction is probably due to the differences between short-term (STM) and long-term memory (LTM). Wortman and Greenberg (1971) have presented evidence that information capable of being hierarchically organized will tend to become so organized--thereby having its impact on LTM.

Shuell's (1969) and Tulving's (1968) reviews of studies guided by organizational hypotheses point out the criticality of organization in the transfer of information from STM to LTM. Organizationally, items in LTM tend to cluster under broader, superordinate categories. The broader category labels are more resistant to forgetting than the individual items subsumed under them. Travers (1972) has discussed this phenomenon in long-term memory: "Loss through forgetting appears to proceed generally in the order of fine detail to broad categories. ... It would also appear that details have some chance of survival in memory systems only when closely tied to ideas at a higher level of generality" (page 143).

In the present study the disordinal interaction in the delayed-recall groups may have been caused by the organization (inherent associations) of the task itself rather than the presentation. The PMSM and PDSD groups, although having had different presentation orderings of the TBR nouns, made their associational connections using the same noun pairs. For both groups, 1-BUN was always linked with an OCCUPATION, 2-SHOE with an ANIMAL, 3-TREE with a part of the BODY, etc. Consequently, subjects were able to search for the TBR nouns through this "tandem" retrieval cue. For example, a typical subject report was: "I used the bun to help remember the occupations, then I just thought of the occupations."

On the other hand, the PMSD and the PDSM groups associated each pegword with one TBR noun from each of the semantic categories (OCCUPATION, ANIMAL, BODY, FOOD, MILITARY, BUILDING, WATER). The same was true for 2-SHOE, 3-TREE, etc.. This evidently complicated the organization in LTM for the PMSD and PDSM delayed-recall groups. Subjects in the PMSD group tended to be unclear about the original presentation of the slides. Four subjects actually described the treatment they had received a week earlier as though it had been the PMSM presentation. This, perhaps, accounts to some degree for the lower recall scores of the PMSD group. It is certain, however, that presentation and task characteristics are important organizational factors in long-term memory and delayed recall.

Conclusions

Overall, the data generally support the organizational models of memory of Mandler (1968) and Bower (1970). Specific support was found for Bower's et al. (1969) conclusion that semantic hierarchical blocking is superior. Wickens' (1972) findings on the power of semantic, taxonomic categories in organization and retrieval was supported by the main effect for the semantic variable.

Two curious findings, the general lack of support for the imagery variable and the interaction as a function of differences in short-term and long-term memory, require further investigation before firmer conclusions can be stated. The lack of support for Paivio's analysis of the organizational power of imagery mnemonics does not imply, however, that imagery is a weak or sterile factor in organization. Variables such as practice (Paivio, 1971; Yuille & Paivio, 1968), presentation time (Bugelski, 1968; Bugelski et al.,

1968; Keppel & Zavortink, 1969), and imagery instructions (Bower, 1972, Yuille & Paivio, 1968) were not manipulated. These variables have been shown to be important factors in imagery studies. In this study, however, subject reports imply that the imagery mnemonic was often forsaken for the more familiar and personally developed uses of semantic categories in organization and retrieval.

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Table 1

Mean Recall Scores and Standard Deviations for Each of the Eight Groups

	Recall condition			
	immediate		delayed	
Presentation mode	semantic massed	semantic distributed	semantic massed	semantic distributed
pegword massed	31.6 8.99	25.3 6.78	19.1 10.15	9.4 5.13
pegword distributed	26.5 6.65	21.2 8.27	11.8 8.22	16.0 10.09

Figure 1. Slide presentations for each group: Display of all combinations of the massed and distributed levels of pegword mnemonic and semantic organization.

PMSM

PEGWORD MNEMONIC	SEMANTIC ORGANIZATION
Massed	Massed
1-BUN	DOORMAN (OCCUPATION)
1-BUN	BUTCHER (OCCUPATION)
1-BUN	PRIEST (OCCUPATION)
1-BUN	TEACHER (OCCUPATION)
1-BUN	BLACKSMITH (OCCUPATION)
1-BUN	JUDGE (OCCUPATION)
1-BUN	PHYSICIAN (OCCUPATION)
2-SHOE	HOUND (ANIMAL)
2-SHOE	ALLIGATOR (ANIMAL)
2-SHOE	BEAVER (ANIMAL)
2-SHOE	LEOPARD (ANIMAL)
2-SHOE	FOX (ANIMAL)
2-SHOE	HORSE (ANIMAL)
2-SHOE	ELEPHANT (ANIMAL)
3-TREE	CHIN (BODY)
3-TREE	BREAST (BODY)
3-TREE	FOREHEAD (BODY)
3-TREE	ELBOW (BODY)
3-TREE	LIP (BODY)
3-TREE	ARM (BODY)
3-TREE	ANKLE (BODY)
4-DOOR	SPINACH (FOOD)
4-DOOR	PEACH (FOOD)
4-DOOR	CORN (FOOD)
4-DOOR	APPLE (FOOD)
4-DOOR	POTATO (FOOD)
4-DOOR	STRAWBERRY (FOOD)
4-DOOR	WHEAT (FOOD)
5-HIVE	TANK (MILITARY)
5-HIVE	WEAPON (MILITARY)
5-HIVE	CAMOUFLAGE (MILITARY)
5-HIVE	TROOPS (MILITARY)
5-HIVE	MISSILE (MILITARY)
5-HIVE	BULLET (MILITARY)
5-HIVE	ARMY (MILITARY)
6-STICK	HOTEL (BUILDING)
6-STICK	SALOON (BUILDING)
6-STICK	FACTORY (BUILDING)
6-STICK	LIBRARY (BUILDING)
6-STICK	RESTAURANT (BUILDING)
6-STICK	INN (BUILDING)
6-STICK	CHURCH (BUILDING)
7-HEAVEN	OCEAN (WATER)
7-HEAVEN	FLOOD (WATER)
7-HEAVEN	GLACIER (WATER)
7-HEAVEN	AVALANCHE (WATER)
7-HEAVEN	SWAMP (WATER)
7-HEAVEN	TYPHOON (WATER)
7-HEAVEN	FIORD (WATER)

PDSM

PEGWORD MNEMONIC	SEMANTIC ORGANIZATION
Distributed	Massed
1-BUN	DOORMAN (OCCUPATION)
2-SHOE	BUTCHER (OCCUPATION)
3-TREE	PRIEST (OCCUPATION)
4-DOOR	TEACHER (OCCUPATION)
5-HIVE	BLACKSMITH (OCCUPATION)
6-STICK	JUDGE (OCCUPATION)
7-HEAVEN	PHYSICIAN (OCCUPATION)
1-BUN	HOUND (ANIMAL)
2-SHOE	ALLIGATOR (ANIMAL)
3-TREE	BEAVER (ANIMAL)
4-DOOR	LEOPARD (ANIMAL)
5-HIVE	FOX (ANIMAL)
6-STICK	HORSE (ANIMAL)
7-HEAVEN	ELEPHANT (ANIMAL)
1-BUN	CHIN (BODY)
2-SHOE	BREAST (BODY)
3-TREE	FOREHEAD (BODY)
4-DOOR	ELBOW (BODY)
5-HIVE	LIP (BODY)
6-STICK	ARM (BODY)
7-HEAVEN	ANKLE (BODY)
1-BUN	SPINACH (FOOD)
2-SHOE	PEACH (FOOD)
3-TREE	CORN (FOOD)
4-DOOR	APPLE (FOOD)
5-HIVE	POTATO (FOOD)
6-STICK	STRAWBERRY (FOOD)
7-HEAVEN	WHEAT (FOOD)
1-BUN	TANK (MILITARY)
2-SHOE	WEAPON (MILITARY)
3-TREE	CAMOUFLAGE (MILITARY)
4-DOOR	TROOPS (MILITARY)
5-HIVE	MISSILE (MILITARY)
6-STICK	BULLET (MILITARY)
7-HEAVEN	ARMY (MILITARY)
1-BUN	HOTEL (BUILDING)
2-SHOE	SALOON (BUILDING)
3-TREE	FACTORY (BUILDING)
4-DOOR	LIBRARY (BUILDING)
5-HIVE	RESTAURANT (BUILDING)
6-STICK	INN (BUILDING)
7-HEAVEN	CHURCH (BUILDING)
1-BUN	OCEAN (WATER)
2-SHOE	FLOOD (WATER)
3-TREE	GLACIER (WATER)
4-DOOR	ALAVANCHE (WATER)
5-HIVE	SWAMP (WATER)
6-STICK	TYPHOON (WATER)
7-HEAVEN	FIORD (WATER)

PMSD

PEGWORD MNEMONIC	SEMANTIC ORGANIZATION
Massed	Distributed
1-BUN	DOORMAN (OCCUPATION)
1-BUN	HOUND (ANIMAL)
1-BUN	CHIN (BODY)
1-BUN	SPINACH (FOOD)
1-BUN	TANK (MILITARY)
1-BUN	HOTEL (BUILDING)
1-BUN	OCEAN (WATER)
2-SHOE	BUTCHER (OCCUPATION)
2-SHOE	ALLIGATOR (ANIMAL)
2-SHOE	BREAST (BODY)
2-SHOE	PEACH (FOOD)
2-SHOE	WEAPON (MILITARY)
2-SHOE	SALOON (BUILDING)
2-SHOE	FLOOD (WATER)
3-TREE	PRIEST (OCCUPATION)
3-TREE	BEAVER (ANIMAL)
3-TREE	FOREHEAD (BODY)
3-TREE	CORN (FOOD)
3-TREE	CAMOUFLAGE (MILITARY)
3-TREE	FACTORY (BUILDING)
3-TREE	GLACIER (WATER)
4-DOOR	TEACHER (OCCUPATION)
4-DOOR	LEOPARD (ANIMAL)
4-DOOR	ELBOW (BODY)
4-DOOR	APPLE (BODY)
4-DOOR	TROOPS (MILITARY)
4-DOOR	LIBRARY (BUILDING)
4-DOOR	AVALANCHE (WATER)
5-HIVE	BLACKSMITH (OCCUPATION)
5-HIVE	FOX (ANIMAL)
5-HIVE	LIP (BODY)
5-HIVE	POTATO (FOOD)
5-HIVE	MISSILE (MILITARY)
5-HIVE	RESTAURANT (BUILDING)
5-HIVE	SWAMP (WATER)
6-STICK	JUDGE (OCCUPATION)
6-STICK	HORSE (ANIMAL)
6-STICK	ARM (BODY)
6-STICK	STRAWBERRY (FOOD)
6-STICK	BULLET (MILITARY)
6-STICK	INN (BUILDING)
6-STICK	TYPHOON (WATER)
7-HEAVEN	PHYSICIAN (OCCUPATION)
7-HEAVEN	ELEPHANT (ANIMAL)
7-HEAVEN	ANKLE (BODY)
7-HEAVEN	WHEAT (FOOD)
7-HEAVEN	ARMY (MILITARY)
7-HEAVEN	CHURCH (BUILDING)
7-HEAVEN	FIORD (WATER)

PDSD

PEGWORD MNEMONIC	SEMANTIC ORGANIZATION
Distributed	Distributed
1-BUN	DOORMAN (OCCUPATION)
2-SHOE	HOUND (ANIMAL)
3-TREE	CHIN (BODY)
4-DOOR	SPINACH (FOOD)
5-HIVE	TANK (MILITARY)
6-STICK	HOTEL (BUILDING)
7-HEAVEN	OCEAN (WATER)
1-BUN	BUTCHER (OCCUPATION)
2-SHOE	ALLIGATOR (ANIMAL)
3-TREE	BREAST (BODY)
4-DOOR	PEACH (FOOD)
5-HIVE	WEAPON (MILITARY)
6-STICK	SALOON (BUILDING)
7-HEAVEN	FLOOD (WATER)
1-BUN	PRIEST (OCCUPATION)
2-SHOE	BEAVER (ANIMAL)
3-TREE	FOREHEAD (BODY)
4-DOOR	CORN (FOOD)
5-HIVE	CAMOUFLAGE (MILITARY)
6-STICK	FACTORY (BUILDING)
7-HEAVEN	GLACIER (WATER)
1-BUN	TEACHER (OCCUPATION)
2-SHOE	LEOPARD (ANIMAL)
3-TREE	ELBOW (BODY)
4-DOOR	APPLE (FOOD)
5-HIVE	TROOPS (MILITARY)
6-STICK	LIBRARY (BUILDING)
7-HEAVEN	AVALANCHE (WATER)
1-BUN	BLACKSMITH (OCCUPATION)
2-SHOE	FOX (ANIMAL)
3-TREE	LIP (BODY)
4-DOOR	POTATO (FOOD)
5-HIVE	MISSILE (MILITARY)
6-STICK	RESTAURANT (BUILDING)
7-HEAVEN	SWAMP (WATER)
1-BUN	JUDGE (OCCUPATION)
2-SHOE	HORSE (ANIMAL)
3-TREE	ARM (BODY)
4-DOOR	STRAWBERRY (FOOD)
5-HIVE	BULLET (MILITARY)
6-STICK	INN (BUILDING)
7-HEAVEN	TYPHOON (WATER)
1-BUN	PHYSICIAN (OCCUPATION)
2-SHOE	ELEPHANT (ANIMAL)
3-TREE	ANKLE (BODY)
4-DOOR	WHEAT (FOOD)
5-HIVE	ARMY (MILITARY)
6-STICK	CHURCH (BUILDING)
7-HEAVEN	FIORD (WATER)

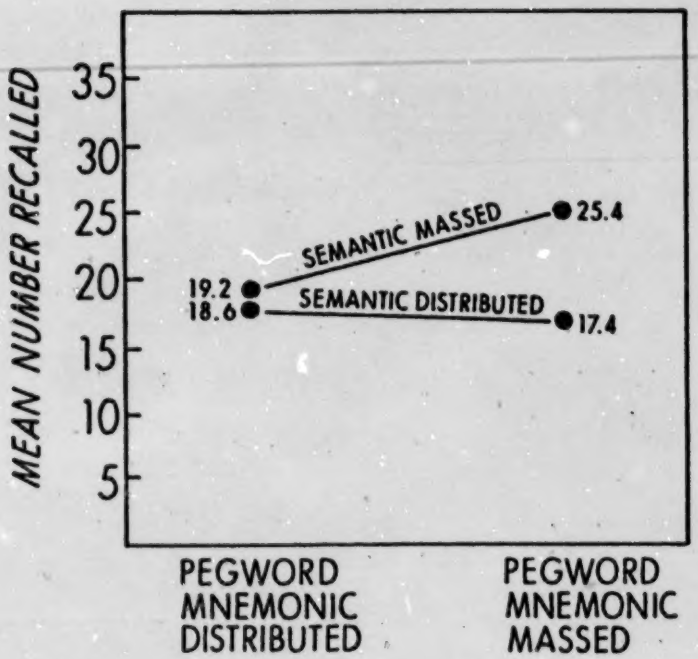

Figure 2. Two-way ordinal interaction between pegword mnemonic and semantic organization.

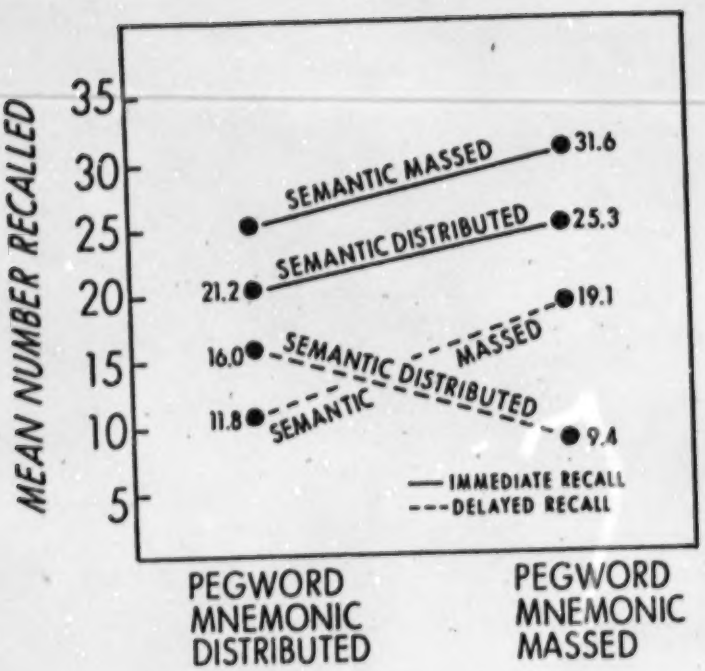

Figure 3. Graph of group means showing the disordinal interaction in the delayed condition in contrast with the lack of interaction in the immediate condition.